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COSC 4368: Fundamentals of Artificial Intelligence Spring 2019

Problem Set2 (Individual Tasks) Version 4

Deadline: Su., March 31, **11a** (3% bonus); Tuesday, April 2, 11p (the latest)

Remarks: About 50% of the available points for Problem Set2 are allocated to Task 10.

**7. Game Theory** Khadija

There are 2 players. Player 1 has 10 dollars. She can choose to give (10 dollars to player 2 and 0 to player 1), share (5 dollars to each player), or keep (10 dollars to player 1 and 0 to player 2). After she makes her decision, which player 2 observes, player 2 can accept or reject. After accepting payoffs are as specified (let’s assume utilities are in dollar amounts), and after rejecting everyone gets 0. i. Describe this game in its extensive form. ii. Describe this game in its normal form. iii. Find all (pure and mixed) Nash equilibria of this game.

**8. Reinforcement Learning** Romita

a) Assume the following world UVW is given:

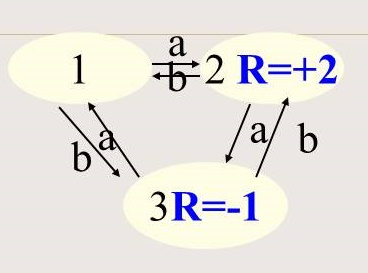


Fig. 1: UVW State Space.

Moreover, the current Q-table contains the following entries:

|  |  |
| --- | --- |
|  | Value |
| q(a,1) | 1 |
| q(b,1) | -0.5 |
| q(a,2) | -0.5 |
| q(b,2) | 0 |
| q(a,3) | 0 |
| q(b,3) | 1 |

Assume the agent is currently in state 2 and her policy always applies action b in every state; how does the updated Q-Table look like after the agent has applied action b the second time[[1]](#footnote-1) in state 2:

1. when Q-Learning is used?
2. when SARSA is used?

Assume that the learning rate α is 0.5 and the discount rate γ is 1. Do not only report the updated value, but also give the formulas for the four Q-table updates.

b) What **advantages** do you see in using SARSA over Q-Learning?

c) What is the main difference between SARSA and Expected-SARSA? In which circumstances do you prefer Expected-SARSA over SARSA?

d) How does reinforcement learning differ from supervised learning, e.g. learning neural networks?

**9. NN and SVMs** Romita

a) What is the purpose of the Backpropagation algorithms; why is it needed?

b) What factors determine the value of back-propagated errors in multi-layer NNs?

c) Give a single[[2]](#footnote-2) technical reason that explains the current popularity of Deep Neural Networks.

d)The soft margin support vector machine solves the following optimization problem:

svn-equation

What does the second term minimize? Depict all non-zero ξi in the figure below! What is the advantage of the soft margin approach over the linear SVM approach?



Fig. 2: SVM Decision Boundaries for a Dataset containing Two Classes.

e) Referring to the figure above, explain how examples are classified correctly by SVMs! What is the relationship between ξi and example i being classified correctly?

**10. Using SVM and NN Tools** Khadija

The goal of this task is to apply different classification approaches to a challenging dataset to compare the results, to enhance the accuracy of the learnt models via selecting better parameters/preprocessing/using kernels/incorporating background knowledge and to summarize your findings in a report.

The dataset you will be using for this task is *the Wisconsin Breast Cancer Data Set*: <https://archive.ics.uci.edu/ml/datasets/Breast+Cancer+Wisconsin+%28Diagnostic%29>

(wdbc.data).

As far as classification algorithms are concerned we will use:

1. Neural Networks

2. Support Vector Machines.

You will use 2 “variations” of each approach:

* As far SVMs are concerned, you should use 2 different kernels (any kernel is fine, you can use the linear kernel as one kenel)
* As far as NNs are concerned, you should use two of the following activation functions: 1. Logistic/sigmoid 2. Tanh or hyperbolic tangent activation function 3. Relu 4. Softplus

Accuracy of the four classification algorithms, you compare, should be measured using 10-fold cross validation. In your report after comparing the experimental results, write a paragraph or two trying to explain/speculate why, in your opinion one classification algorithm outperformed the other. Finally, at the end of your report provide a 1-2 paragraphs summary that summarizes the most important findings of this task.

**Deliverables:**

Please submit both the report and the source code file.

**Suggestions:**

You can use built-in functions in python and R.

For python, it’s preferable to use Scikit-Learn for both SVM and neural network.

For R, we suggest the ‘Neuralnet’ and ‘svm’ functions.

**11. FOPL as a Language** Khadija

Represent the following sentences using FOPL:

a. There is a least one corrupt politician in San Antonio.

b. Every man loves a least one woman.

c. Neither red frogs nor green frogs eat grass.

d. There are at least 2 yellow houses in Harris County that have been flooded.

e. There is a dogcatcher in Texas who caught at least one dog in every county in Texas.

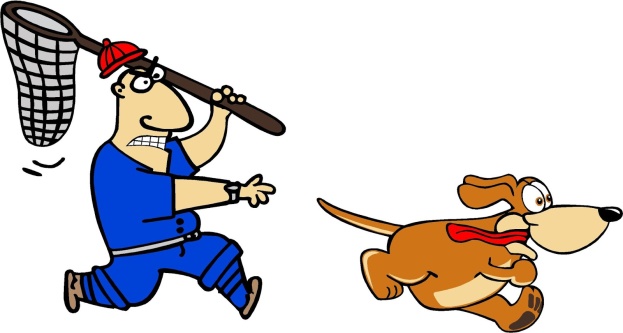


Fig. 3: Texas Dogcatcher in Action.

Dogcatcher Salaries: <https://www.salaryexpert.com/salary/job/dog-catcher/united-states/texas/fort-worth> [[3]](#footnote-3)

**ProblemSet2 Submission Guidelines:**

Create a folder and name it as LastName\_StudentId\_HW1. HW1 folder should include all the above mentioned files. Submit the LastName\_StudentId\_HW1 folder in a zipped file through Blackboard.

1. —after applying b-b-b-b [↑](#footnote-ref-1)
2. There might be multiple technical reasons! [↑](#footnote-ref-2)
3. Just in case you plan to look for a non-computer science job after your graduation. [↑](#footnote-ref-3)